

ULTRAVIOLET LASER ABLATIVE PATTERNING OF MICROSTRUCTURES IN SEMICONDUCTORS

ABSTRACT OF THE DISCLOSURE

Patterns with feature sizes of less than 50 microns are rapidly formed directly in semiconductors, particularly silicon, using ultraviolet laser ablation. These patterns include very high aspect ratio cylindrical through-hole openings for integrated circuit connections; singulation of processed die contained on semiconductor wafers; and microtab cutting to separate microcircuit workpieces from a parent semiconductor wafer. Laser output pulses (32) from a diode-pumped, Q-switched frequency-tripled Nd:YAG, Nd:YVO₄, or Nd:YLF is directed to the workpiece (12) with high speed precision using a compound beam positioner. The optical system produces a Gaussian spot size, or top hat beam profile, of about 10 microns. The pulse energy used for high-speed ablative processing of silicon using this focused spot size is greater than 200 μ J per pulse at pulse repetition frequencies greater than 5 kHz and preferably above 15 kHz. The laser pulsewidth measured at the full width half-maximum points is preferably less than 80 ns.